

Research on AT Outcomes and Large Scale Assessments

Martha Thurlow
National Center on Educational Outcomes

Gerald Tindal
University of Oregon

Richard Powers
TextHelp®

Preston Lewis
University of Kentucky

Cara Cahalan Laitusis
Educational Testing Service

Joan Breslin-Larson
Minnesota Department of Education

Abstract: Current educational policies require the participation of students with disabilities in state assessments. Their participation has raised a number of issues, among them the need for accommodations. In this article we consider the role that assistive technology (AT) can play to alleviate current accommodations demands, and highlight research and practice on assistive technology outcomes in large-scale assessments. The variability in states' accommodation policies, and the consideration of AT as accommodations, heightens the importance of attending to AT in state assessments. Examples of assistive technology in current state assessments, including Kentucky, Minnesota, and Oregon, are presented. Several current and emerging research activities in this area are highlighted as well. We conclude by suggesting outcomes and benefits, and identifying issues that remain to be addressed.

Key Words: Assessment, Accommodations, Constructs, Accessibility

Today students with disabilities are included in large-scale assessments – state and district tests of achievement – at a rate that probably would not have been thought possible a mere 15 years ago. For some time, these students were purposely excluded, sometimes out of an apparent concern about the stress of the experience of taking a test, but also out of a documented tendency for educators not to want to be held accountable for students they thought would perform poorly (Allington & McGill-Franzen, 1992). Exclusion rates were variable across states (McGrew, Thurlow, & Spiegel, 1993) and districts (Zlatos, 1994), with some states and districts having participation rates as high as 90% when others were below 10%. While most states had participation rates around 10% of students with disabilities in the early 1990s (Shriner, Spande, & Thurlow, 1994), the participation rates in the 2003-2004 school year averaged 97% at the elementary school level, 96% at the middle school level, and 90% at the high school level (Thurlow, Moen, & Altman, 2006)

The increase in participation rates has been due to three primary factors. First, two federal policies have contributed to increased participation of students with disabilities: the (a) Individuals with Disabilities Education Act of 1997 (IDEA '97) required that students with disabilities be included in regular statewide assessments, with accommodations as appropriate (and that those who could not be assessed with regular assessments be assessed through an alternate assessment); and (b) No Child Left Behind Act (NCLB) of 2001 added accountability to the participation requirements. The reauthorization of IDEA (Individuals with Disabilities Education Improvement Act of 2004; IDEIA) reinforced the alignment of IDEIA and NCLB (see Cortiella, 2006).

Second, many educators and policymakers are coming to the realization that the exclusion of students from assessments generally means that they are also left out of the benefits of access to standards-based educational systems. Without the push of the assessment evidence, the drive to focus on the content instruction often is missing. In the current context of quality assessments, content-related evidence is collected through alignment studies to establish links between the standards and test items. As states participate in peer reviews of their assessments and submit evidence of the technical adequacy of both their regular assessment and their alternate assessments, alignment evidence is increasingly being used to refocus the content of assessments. Clearly, students who are not part of an instructional program related to the content standards are at risk of performing poorly on the tests.

Third, the provision of accommodations has contributed to increased participation rates (Koenig & Bachman, 2004). Accommodations are changes in assessment materials or procedures that help ensure that assessments produce valid measures of a student's knowledge and skills. The range of

accommodation options that are subjected to research and that are used in practice has increased dramatically during the past decade (Johnstone, Altman, Thurlow, & Thompson, 2006; Thompson, Blount, & Thurlow, 2002; Tindal & Fuchs, 1999; Zinesky & Sireci, 2007). In part, both changes in legislation and implementation have heightened awareness and increased attention to accommodations both in what they mean and in how they can be implemented. Assistive technology (AT) in large-scale assessments was identified as a major national issue at an AT Outcomes Summit in 2006 (Parette, Peterson-Karlan, Smith, Gray, Silver-Pacuilla, 2005). At this Summit, many individuals representing diverse constituencies conducted discussions to clarify the inherent issues related to the effects of AT on educational outcomes.

This article is a follow-up to discussions at the AT Outcomes Summit. We have considered the role that AT can play to alleviate the current accommodations demands, as well as the need for professional development and other implementation issues. Our purpose is to highlight research and practice on assistive technology outcomes in large-scale assessments. First, we review current accommodation policies on assistive technology on state assessments. Then, we present several examples of assistive technology in current state assessments, including Kentucky, Minnesota, and Oregon. Finally, we highlight several current and emerging research activities in this area – research by Jerry Tindal, Preston Lewis, and Cara Cahalan-Laitusis.

State Assessment Accommodation Policies

The National Center on Educational Outcomes has documented state assessment accommodation policies since the early 1990s (Clapper, Morse, Lazarus, Thompson, & Thurlow, 2005; Lazarus, Thurlow, Lail,

Eisenbraun, & Kato, 2006; Thurlow, House, Boys, Scott, & Ysseldyke, 2000; Thurlow, Lazarus, Thompson, & Robey, 2002; Thurlow, Scott, & Ysseldyke, 1995; Thurlow, Seyfarth, Scott, & Ysseldyke, 1997; Thurlow, Ysseldyke, & Silverstein, 1993). While there initially was considerable confusion in the field about terminology, there is now general consensus about the need to ensure that the accommodation produces a valid score – one that does not violate the construct being measured. When there are questions about this, states begin to use other terms, such as “modification,” “non-standard administration,” and “non-allowed accommodation.” These distinctions are not all that clear, however, and when we move into the realm of AT, they sometimes become more blurry than usual.

State accommodation policies have become much more complicated over time, with states reflecting the fine distinctions of whether an accommodation may violate the construct being assessed in one content area but not another content area. The complexity of policies has been reflected over time in a changing coding system for documenting the policies (Thurlow, 2007).

It is only recently that NCEO has begun to document AT in states’ accommodation policies (Lazarus et al., 2006). To a large extent, this is because AT did not appear in the policies to any great extent until recently. It may be that the students who were using AT were excluded, or that the documentation of the technology was global in nature. While empirical results represent the gold standard, the rapidly changing field often cannot wait for these results, and policy is set based on strong rationale and reasoned judgments.

Assistive Technology Implementation in State Testing

Kentucky Implementation of Assistive Technology in State Testing

Like most states, Kentucky regulations require that accommodations used in state assessment be based on their ongoing use in the classroom setting: “Accommodations or modifications shall be part of the student’s ongoing instructional program and not introduced for the first time during state-required Assessment” (703 KAR 5:070, §6(2). During the state-required assessment, a student with a disability or limited English proficiency may use special equipment, including assistive or adaptive technology described in the student’s individualized education program (IEP), 504 Plan or Program Services Plan, which is part of the student’s regular instructional routine [703 KAR 5:070, §6(B)]. Historically, AT was used during the state assessment to facilitate access to the print based or audio-taped version of the test (e.g., magnification, amplification, etc.) or to support a student’s response (e.g., use of a communication device, word processor). Beginning in Spring of 2003, the use of AT was dramatically changed from primarily use with the paper or audio-taped version of the test, to use of AT to interact with and respond to an accessible electronic version of the test. This was known as Commonwealth Accountability Testing System (CATS) Online.

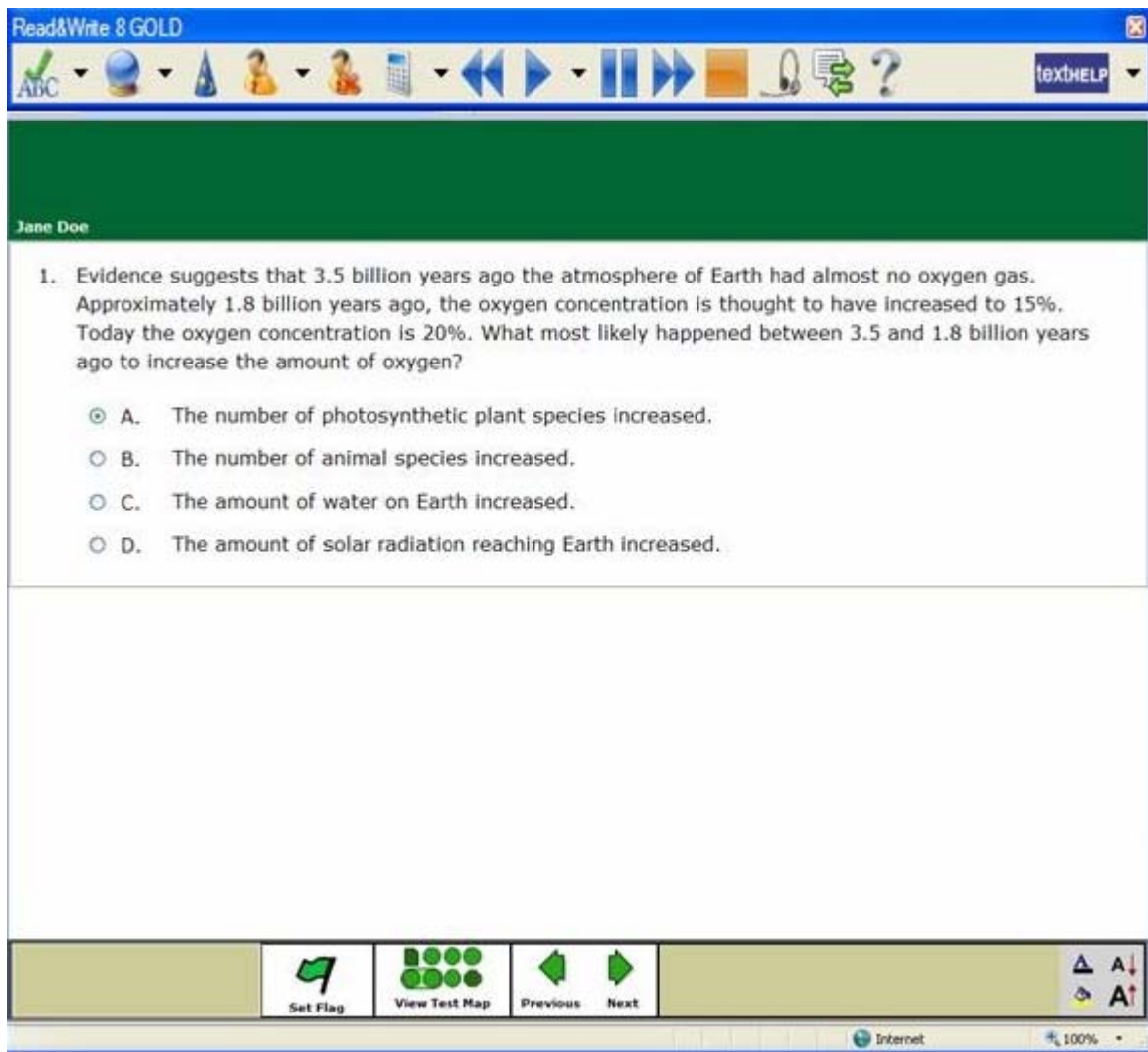
CATS Online is part of the overall Universal Design for Learning (UDL) initiative of the Kentucky Department of Education (KDE; Kentucky Department of Education, 2007). One of the factors that has accelerated use of AT in both instruction and assessment was the decision by the KDE in 2002 to enter into a volume purchase agreement with an AT vendor (i.e., Texthelp®, Inc.) for provision of text reader technology (i.e., Read & Write

Gold/RWG). This agreement included a 50% discount in the purchase price of RWG by the state education agency, local education agency, or parents. As a result, to date 1350 (95%) of Kentucky schools have acquired a site license for use of RWG. The site license approach has allowed for each school to install RWG on any computer in its respective school, enabling children to have access to the general curriculum given its availability and

use both in special and general education settings.

The infusion of RWG in the classroom accelerated interest in its being available as an accommodation for use with the state assessment, which led to the KDE administrative decision in 2003 to provide an accessible electronic version of the state assessment (i.e., CATS Online). The RWG

Figure 1. Student online view of a typical multiple choice science item, as presented in the 2007 Kentucky CATS Online Assessment. [Note: Sample item is from iTest system by Measured Progress, Inc. (<http://www.measuredprogress.org/>); Tool bar is from Read & Write GOLD by Texthelp®, Inc. (<http://www.texthelp.com>). This sample test item is from the 2007 assessment system, not the system described in this article, which is no longer available.]



site license purchase agreement also facilitated availability of the software for simultaneous use on multiple computers during state testing. Participation in CATS Online by students with disabilities has grown from use by 204 students from 29 schools in 2003, to use by 2,306 students from 200 schools in 2006 (Kentucky Department of Education, 2006). A sample test item from the 2007 assessment system is presented in Figure 1.

Important changes have been reported by students and teachers as a result of use of this technology during state assessment. The most frequent comment from students is the newfound independence afforded to students by use of their AT to read and re-read passages, questions and for response (CATS Online Post-Test Student Survey, Kentucky Department of Education, 2005). In post-test surveys, 84% of teachers stated that students were more engaged with the online assessment than with previous use of the paper version (CATS Online Post-Test Teacher Survey, Kentucky Department of Education, 2005). It is of interest to note that 91% of students surveyed said they thought they scored better by testing on computer

using their AT. While more aggregated analysis of student results is needed to verify possible impact on student performance, there are instances reported by local school districts of improved results (Henry F. Moss Middle School, 2005; Lawrence, 2005).

Regardless of impact on performance, it is clear that use of this technology changes the way students approach participation in state assessment. As recently stated by one 10th grader, "I like being on the computer and not having someone read to me like a kid" (CATS Online Post-Test Survey, 2005). Given the proliferation of AT and increasing computer access, coupled with SEA efforts to implement the IDEIA 2004 requirements for implementation of universal design of assessment [§ 61216(E)] it seems not to be a matter of "if," but "when" all other states and districts will move into offering similar options for use of AT as an accommodation for

Three other states have piloted electronic accessible assessments. At the 2005 Council for Exceptional Children (CEC) Annual Convention and Expo, a poster session titled,

Table 1
Sample of State Accommodation Policies for Students with Disabilities – 2005

Response Accommodation	N States Allowed	N State Allowed with Restrictions	N States Prohibited
Proctor/Scribe	35	13	0
Tape Recorder	33	4	0
Computer/Machine	27	17	0
Sign Responses	26	4	0
Communication Device	24	4	0
Speech to Text	15	4	0
Spell Checker	13	16	2

Source: Adapted from: Lazarus, S. S., Thurlow, M. L., Lail, K. E., Eisenbraun, K. D., & Kato, K. (2006). *2005 state policies on assessment participation and accommodations for students with disabilities* (Synthesis Report 64). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Used with permission.

“Using Technology for Success in High States Testing for Students with Learning Disabilities,” (Pokorni, 2005) presented state assessment efforts in Kentucky and Maryland. The effort in Maryland is based on use of a locally scanned version of the paper test in a few schools using TestTalker software.

In Massachusetts, approximately 249 students with disabilities in grades 3-12 took the Massachusetts Comprehensive Assessment System (MCAS) in 2006 using Kurzweil software to scan and read a paper version of the test (Dan Wiener, personal communication, April 26, 2007). Kansas has offered select grades and content areas online, and has included an option for student use of a built-in text-to-speech system (University of Kansas, 2007).

Except for the Kansas accessible assessment, a notable difference between the efforts of the states mentioned above and the Kentucky online model is that many of the current electronic offerings in other states are based on scanning a paper copy of the test. This is in contrast to CATS Online which consists of total re-creation of each individual question and response option in a single accessible screen. A major difference exists between copying an inaccessible paper design into electronic format and the full scale conversion of the test onto an accessible platform for student access. Students with disabilities have been noted to have difficulty with fundamental testing tasks such as selectively attending to test items when presented sequentially or in columns on a page, which is then often compounded by having to respond on a separate answer sheet. Using a scanned format of the paper version does not overcome these barriers. By having one item at a time on the screen for students to focus on and with navigation tools to move quickly back and forth between items, the CATS Online model is much more conducive to student use. Additionally, the ability to simply

click on a radial button for electronic submission of a response overcomes the myriad of problems of finding and acting on the desired response on an answer sheet—a problem experienced by many students with perceptual and or motor difficulties.

Minnesota Implementation of Assistive Technology in State Testing

The use of AT in Minnesota large-scale assessments is an evolving practice. As the participation of students with a range of disabilities increases, so too does the need to broaden the understanding of what constitutes appropriate accommodations for the student’s use during testing situations.

The Minnesota Department of Education has been aware of both the need to ensure students have appropriate access to accommodations and the need for the field to have timely information. The Department publishes an annual document providing technical assistance to the field (Minnesota Department of Education, 2007b). This document includes a chapter dedicated to accommodations in testing, and lists a range of supports that are allowable and the appropriate codes to document the type of accommodations used by the student. This document and a range of updates are available online (see Minnesota Department of Education, 2007a).

The discussion of what is “acceptable” is reviewed annually, through discussion between the Assessment office at the Department and the Special Education office. These conversations have occurred for the past 10 years. As a result of these conversations, the use of some accommodations previously determined not to be appropriate have now been included as acceptable. This evolution has occurred as the understanding of the demands of using certain accommodations has been clarified.

Figure 2. Lessons learned about making effective decisions about the use of AT.

1. Collaboration between Special Education and Assessment Divisions as well as with AT personnel, and if computers are used, technology/network personnel, is essential.
2. Discussions about what is “acceptable” need to occur annually (at a minimum) and need to be based on knowledge of testing, potential technologies, and disability.
3. Decisions are facilitated by demonstrations of AT so that the rigor involved in use of AT is evident.
4. It is important to discuss and make clear the conditions placed on the use of AT for assessment.
5. The use of AT may not make testing tasks easier, but it may allow for performance of the task, and thus a more valid representation of the student’s knowledge and skills.

Voice recognition is one technology that was viewed as providing an additional advantage to students in testing situations. This view was changed after a demonstration of the rigor required in the use of the technology.

The use of portable notetakers such as a Neo™ or the Writer™ is also now allowable, as are spellcheckers or word prediction programs if these are accommodations used by a student and included in the IEP as necessary during assessment. Scribes are an allowable accommodation, as are the use of visual templates, large print, Braille or the use of tape recorders to dictate answers. Some tools are allowable for all students, including the use of an abacus or calculators for parts of the math test that do not specifically limit their use (such as estimation).

We have learned that collaboration between the Special Education Division and the Assessment Division is essential in making effective decisions regarding the use of AT in large-scale assessment. A priority for staff in the Special Education Division is to stay

aware of changes inherent in the use of AT (Joan Breslin-Larson, personal communication, May 13, 2007). Test developers are generally not aware of the range of AT devices available or that use of a particular technology is not intuitive and will not necessarily provide additional benefit to a student with a significant disability. Presented in Figure 2 are lessons we have learned related to effective decision-making about AT usage.

The use of AT may not make testing tasks easier, but it may allow for performance of the task, and thus a more valid representation of the student’s knowledge and skills.

The Minnesota Department of Education has identified that IEP teams need to make data based decisions in choosing accommodations used in large-scale assessments, including the IEP team considering what technologies a student currently has use of in completion of class work and what challenges might exist in a testing situation. The Department has undertaken a General Supervision Enhancement Grant (Minnesota Department

of Education, 2007 Grant No. H326X060008) to determine several points, including whether there is symmetry between student classroom accommodations, including AT, as documented in the IEP and the documentation of AT and other accommodations for large scale assessments.

The Department will remain vigilant in monitoring what technologies are available, what students use in their daily education, and what is important to effectively measure what students know and can demonstrate.

Oregon Computer-Assisted Statewide Testing Program

In Oregon, a computer-assisted test (CAT) is used to present and score reading and mathematics tests. Unlike simply delivering an item to students using a computer (referred to as computer-based testing), a CAT presents items to students using the student's performance levels to dynamically adjust the difficulty level of each successive item. For example, if an item is answered incorrectly, then the next item being presented is easier; in contrast, if an item is answered correctly the next item presented is more difficult. With each item presentation, the reliability of any estimates of the student's performance is calculated; when a specified level of reliability is reached, no new items are presented and the testing session is complete.

This type of testing is considered optimal in that items viewed as most appropriate for the student are used instead of difficult items where the performance levels of the student are low. With item-response theory (IRT; Wikipedia, 2007), where the difficulty levels of items are defined, this type of testing is quite easy to implement. The use of computers to adjust difficulty levels is a form of AT according to Tindal and Crawford (2005). This type of assessment is not possible without a computer, which provides for a

dynamic algorithm that adjusts item difficulty according to student ability (or skill proficiency).

Many believe that CAT makes great sense for students with disabilities, even though it may not be accepted for current NCLB assessments. Once a computer becomes the mechanism for delivering a test, regardless of whether CAT is used or not, a number of substantive accommodations also become possible. These accommodations can be grouped into those commonly described in the literature: time, setting, presentation, and response. Of course, some of these accommodations are immediately available while others are likely to be developed in the very near future, especially given the rapid rate of change in technology.

The Oregon statewide testing program is described here as an example of what can be accomplished with computer-based and computer-assisted testing. This is not an exhaustive description of what is being done in Oregon.

Obviously, the way in which *time* is manipulated can be varied on a number of dimensions. First, the test session can be completely flexible with group administration. Rather than having students either given too much time or not enough time, it is possible to individualize time more flexibly (of course, this assumes a computer is available for the student to use). Nevertheless, group administration need not force strict equality in the amount of time and scheduling of that time. For example, it would be possible to begin a testing session in a lab but when the allotted time is used in which most students are done, all students can continue with other school activities with a subset of students needing more time taking the test in another session in their classroom or returning to the computer lab.

Settings are only as flexible as the computer configurations in the building and may vary from computers on wheels to fixed computer labs. In adjusting the setting, students can begin in one setting and then move to another. With a test presented at a URL, access is completely open and the only issues that need to be addressed are those about the standardization of administration. For students needing more quiet or separate places to complete the test, any location with a computer can be selected.

A number of *presentation* accommodations can be used with CBT and CAT. For example, in mathematics, a number of read aloud accommodations are possible. In previous research (Tindal & Ketterlin-Geller, 2004), students have taken the test with headphones and had the opportunity to hear problems and answer options being read. In this research, the read aloud was done with human readers though increasingly sophisticated computer-generated reading is now possible. Dynamic magnification is possible with a computer-based test administration. Web sites can be adjusted to allow text to be expanded both incrementally as well as nearly infinitely (from a mere 2-point increase to a 48-point increase). Obviously, this magnification may create other problems just as it does with paper and pencil testing. For example, while a paper-pencil version would require more pages, the computer version would require more scrolling. Both, in turn are likely to require more time. Finally, any number of 'page layout' options are possible to make dynamically with the following representing a few of the possibilities: (a) the size of the screen; (b) the number of items presented on the screen; (c) the use of horizontal versus vertical juxtaposition of prompts and passages; and (d) supports available (e.g., highlighting tools, erasers, separate screens to take notes) that may be built into the computer. Importantly, all of these changes can be accessed on a 'need to use' basis with

individual items rather than a 'have to use' basis with the entire test.

In summary, computer-based and computer-assisted tests are uniquely situated to serve as an excellent host environment for allowing accommodations to be used in a flexible and responsive manner. Both students and teachers can benefit by making these adjustments for individuals and individual items, useful only when they are needed.

Implementation of TextHelp Systems in State Testing

Read&Write GOLD, from Texthelp® Systems, is an award-winning literacy productivity tool designed to help struggling students by allowing them to access curriculum content on a computer and complete reading, writing and research assignments as well as tests independently. Read&Write GOLD levels the playing field for all students, including those with learning difficulties, dyslexia, and English Language Learners. The program allows students with low reading and writing proficiency to work on their own alongside their peers in the classroom.

The product provides a unique approach to AT since Read&Write GOLD is an easy-to-use toolbar that floats on top of any mainstream Windows® application so that documents and tests do not have to be transferred into any other format or scanned into another application. The many features of Read&Write GOLD include: (a) dual highlighting as text is read aloud using natural sounding voices, (b) spell checker, (c) dictionary, (d) calculator, (e) word prediction, (f) internet research tools, (g) Spanish translator, (h) MP3 file creator, and (i) scanning. Texthelp® is continuously adding and refining the features and tools in the product to take advantage of the latest technology innovations and to meet the ever

increasing need for solutions for individuals with literacy difficulties.

Read&Write GOLD allows students to complete required testing with the same questions and using the same format as all other students. Texthelp® Systems provides security for the tests online to ensure the integrity of the testing. Read&Write GOLD has been an important support to students not only during testing time but also during their regular classes. For teachers, this addresses the mandate to test in the same manner as one teaches.

The use of Read&Write GOLD is increasing across the country. The Columbus, Ohio, Public Schools secured a license for every school in the district. TextHelp® Systems has provided training for the district so that the use of the software is implemented for the students in a manner to ensure understanding and continued use. It has been found that the use of Read&Write GOLD by non-diagnosed learners (i.e., typical students who independently use the tool) is increasing as users become aware of its advantages.

Over 170 schools in Toronto, Ontario, have been using Read&Write GOLD for the past six years. Steady student progress has been measured since its implementation, and the district has continued to upgrade as the software has improved and strengthened. The state of Minnesota selected Read&Write GOLD for all the pilot schools in its Universal Design for Learning activities (Joan Breslin-Larson, personal communication, May 13, 2007). Conversations with personnel from the Missouri Department of Elementary and Secondary Education have also been initiated regarding the use of Read&Write GOLD in targeted schools (David Baker, personal communication June 7, 2007).

As the use and acceptance of assistive technology matures and similar products

come onto the market, Read&Write GOLD is being selected, used, and often required in schools across the country. While there is not yet evidence of the number of students using Read&Write GOLD during statewide assessments, or even of the number of states that specifically allow its use, it is likely that with its increased instructional use, there will be a corresponding increased use in assessment.

Research on AT and Outcomes

Technology Assisted Reading Assessment

Educational Testing Service (ETS), a non-profit educational measurement organization has long been a leader in standardized large scale assessments. Over the last 25 years ETS researchers have examined the impact of testing accommodations, computer-based testing, and disability-related access on the validity of test scores used for college and graduate school admissions. These projects have included the prototype development and evaluation of a self-voiced test for blind test takers (Hansen, Forer, & Lee, 2004; Hansen, Lee, & Forer, 2002); the comparability of paper and computer-based tests (Gallagher, Bridgeman, & Cahalan, 2002); and the evaluation of psychometric properties of Braille and large print test forms (Bennett, Rock, & Novatkoski, 1989). More recently researchers have begun to focus on improving large scale K12 assessments for students with disabilities and developing assessments specifically for students with disabilities.

In 2006, ETS received a grant from the U.S. Department of Education's National Center for Special Education Research (NCSE) to develop a prototype assessment of Technology Assisted Reading Assessment (TARA) and research the psychometric properties of state K-12 assessments for students who are blind or visually impaired. The preliminary results from the

psychometric research indicated that both the Braille and large-print test forms were comparable to the standard test form in terms of relative item difficulty, but that some types of test questions were more likely to change the item difficulty. For example, test questions associated with traditional reading passages (e.g., textbook excerpts, drafts of student papers, letters) were less likely to change in item difficulty between test forms, and test questions based on unique passages (e.g., advertisements, instructional manuals) were more likely to be relatively more difficult for students who took a large print or Braille test form. These results may be due to factors outside of the tests characteristics, such as the curriculum sequence followed by teachers of the visually impaired, access to different instructional materials, or opportunity to learn but can be used to inform both test development and instruction. For additional information on this study see Stone, Cook, Laitusis, and Cline (2007).

In addition to psychometric research another primary purpose of the TARA project is to develop a prototype Technology Assisted Reading Assessment™. The purpose of the Technology Assisted Reading Assessment™ is to measure a student's ability to independently access text using AT (e.g., screen readers, refreshable Braille display, screen magnification) and serve as one part of a modified assessment of reading for the accountability requirements of NCLB. The TARA will be an on-demand performance assessment which requires the student to complete a series of tasks from basic (e.g., open an electronic textbook) to advanced (e.g., scan a printed document and open it or navigate to a particular portion of a document using a screen reader). It is anticipated that student performance will be scored based on both relative speed and accuracy (see www.ets.org/TARA). In preparation for development of this assessment the National Center for Education Outcomes (NCEO) is

conducting a survey of AT users (in grades 7 through 9) and their teachers. The results of this survey will serve to inform a test blueprint that will define the construct to be measured (technology assisted reading) and the knowledge, skills, and abilities (KSA) that will be assessed directly. Information on the survey results and progress of the TARA project are available on the project website (see www.ETS.org/TARA).

Accommodation Station

The accommodation station (AS) was developed from two Office of Special Education Program grants (H327A020043 and H324D020015). This web-based assessment system was designed to provide teachers and IEP teams with more objective data to use in making accommodation recommendations. The software in the system includes a number of assessments of students' reading and mathematics skills, a number of survey questions about teacher and student perceptions and perspectives, and a comparison between the use of accommodations and the lack of their use. After students and teachers input their responses, a report is generated that should allow teacher teams to make informed decisions about accommodations. In the initial software, students were assessed on their skills in reading sentences and answering comprehension questions, their silent reading fluency, and their skill in filling in missing words of sentences, as well as mathematics skills. Other useful academic skills can also be entered. Teachers from both general and special education, as well as the parents of students, can address perceptions of abilities, experiences with accommodations, proficiencies, and the proposed utility of accommodations in the decision-making process. Finally, a comparison can be made between pre-trial attempts with accommodations and those attempts made

without accommodations to help in making decisions.

Outcomes and Benefits

Use of AT to support student participation in large-scale assessment begins to change the traditional view of AT as an individualized treatment (Rose, Hasselbring, & Zabala, 2004) to the much broader area often reserved for

more mainstream instructional technology (IT). Although AT may have been individually prescribed in a student's IEP, once it is to be used for participation in large-scale assessment, a whole series of issues arise that must be addressed systemically well beyond the special education community (see Figure 5).

A fundamental issue is that AT has typically

Figure 5. Issues to address about AT in large-scale assessments.

1. AT needs to be understood by others beside special education personnel; this includes general education practitioners, assessment personnel, and test developers, at a minimum.
2. Partnerships of general education and special education professionals, as well as information technology and network professionals, are essential to address a variety of challenges (networks, firewalls, security, etc.).
3. Various AT software used locally needs to be checked for compatibility with any computerized test that is developed.
4. Simultaneous testing of students online requires multiple copies of AT software, thus requiring exploration of volume purchases or school/district site licenses.
5. The accessibility of the computerized test will need to be addressed so that AT tools work.
6. The use of assistive technologies will need to be considered by test developers because these technologies will have an impact on typical security systems or test delivery methods.
7. Determining how to go about implementation is important; one strategy is to plan big, but start small (phase in by grades, areas of the state, etc.).
8. Identify the minimum hardware specifications required for local online testing (i.e., speed and capacity).
9. Help desk supports that are provided during live testing must be trained, plentiful, and readily available.
10. Online test design needs to include mode for electronic capture and scoring of student responses.

remained primarily in the realm of special education, with a special education teacher or AT specialist the main players facilitating its use. When AT moves into the realm of application during large-scale assessment, a host of new school and district staff have to come to the table to understand its use and integration, especially if it is to be used to support computerized delivery of the assessment. Previously there may have been a tendency by those outside of special education to view themselves as not being responsible for the use of AT; however, AT now becomes embedded within the larger systemic responsibility inherent to administration of accountability assessment.

An array of general education personnel who may have no previous experience with AT design or purpose will need to understand the uniqueness of AT usage. This can include district or school instructional technology personnel, tech support staff, school and district assessment coordinators, school administrators and possibly even the vendors who are involved in state or local delivery of the assessment. While such collaboration between special and general education professional for AT use may have been desired or sought all along, such partnerships are essential if AT is to be used during large-scale assessment. For instance, the tech support staff will want to know how it integrates within the school or district network. There may for example be security issues that arise with the AT and network integration, such as local firewalls that may impede such software or hardware being used.

A major issue is taking AT from individual use to the larger scale required for simultaneous use by multiple students, which raises issues of access to sufficient number of copies of AT software and related cost factors. AT sources and products used are often diverse, even within the same school or class, which means a range of types of AT will

need to be tested for local compatibility with the many and varied hardware stations that often need to be employed when all students are expected to be taking the test at the same time. There is also the issue of tech support for AT during state assessment, which may have typically been relegated to one AT specialist, but when being used by multiple students simultaneously to take the state test, then each student must have immediate access to informed support. In these instances, the test cannot be put aside to wait until someone who is knowledgeable has time to visit the school.

If AT is to be used to support student participation in computerized assessment, then a unique set of issues emerge regarding the interaction of the AT with the assessment. While foremost is the need for the assessment to be available in digital format, accessibility of that format is also paramount. For example, if a text reader is to be used, then the test must be made accessible for text selection using a mouse to allow computerized reading. Most computerized assessments are “locked” by design to prevent such access for security reasons. A balance needs to be maintained between the requirements of test security and accessibility of content for interaction with AT tools. Student response is also of concern since there may be AT software tools that need to be selectively disabled during testing such as word prediction, talking dictionaries or spell check programs.

Identifying and planning for how to deal with the extensive number of issues related to AT use during large-scale assessment entails considerable time and communication across many parties. This may require a phased implementation approach, which could include small scale demonstrations. The gradual introduction of AT may be at certain grades or content areas, with initial participation being voluntary. Time is allowed

then for the staff training and facility preparation that will enhance the chances of success during live test administration. If a problem occurs, then having it happen during a smaller, pilot administration where security, time, scoring and student or school accountability are not at risk is better. It will also be imperative to have alternative delivery systems for the test available, so that students who use assistive technologies will not be inadvertently excluded from participation in testing due to technology incompatibility or test parameters that do not allow for use of technology.

While a main benefit of AT use during large-scale assessment may be the removal of unintended test constructs (e.g., decoding, vocabulary, word recognition, etc.) unrelated to what is being measured (Dolan, Hall, Banerjee, Chun, & Strangman, 2005), an incidental benefit is the increased understanding and familiarity across the school and district both with the technology and the students who use it, not just for purposes of assessment, but also for ongoing instructional support during daily routines. It has been documented that school administrators and school policies can either facilitate or inhibit the acquisition and or use of technology by students with mild disabilities (Goldman, Semmel, Cosden, Gerber & Semmel, 1987; Higgins & Zvi, 1995; Okolo, Rieth, & Bahr, 1989). The increased use of AT an accommodation during large-scale assessment can serve to bolster administrative understanding and increase support of AT use not only for assessment but also for instruction. This is important to changing the historical view of AT being primarily for individuals with moderate or severe disabilities and overcoming reluctance of school administrators to provide AT for students with mild disabilities (Edyburn, 2005).

When AT usage is connected to student performance on large-scale assessment, interest in its nature and use becomes escalated to an administrative level heretofore not experienced by special education professionals or the students. Although its previous use in accordance with an IEP may have generated little concern outside of the special education setting, the application of AT during large-scale computerized assessment raises attention and interest across school and district staff.

References

- Allington, R., & McGill-Franzen, A. (1992). Unintended effects of reform in New York. *Educational Policy*, 6, 397-414.
- Bennett, R. E., Rock, D. A., & Novatkoski, I. (1989). Differential item functioning on the SAT-M Braille edition. *Journal of Educational Measurement*, 26(1), 67-79.
- Clapper, A.T., Morse, A.B., Lazarus, S. S., Thompson, S. J., & Thurlow, M. L. (2005). *2003 state policies on assessment participation and accommodations for students with disabilities* (Synthesis Report 56). Minneapolis MN: University of Minnesota. National Center on Educational Outcomes.
- Cortiella, C. (2006). *NCLB and IDEA: What parents of students with disabilities need to know & do*. Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- Dolan, R. P., Hall, T. E., Banerjee, M., Chun, E., & Strangman, N. (2005). Applying principles of universal design to test delivery: The effect of computer-based read-aloud on test performance of high school students with learning disabilities. *Journal of Technology, Learning & Assessment*, 3(7).
- Retrieved May 7, 2007, from <http://escholarship.bc.edu/cgi/viewcontent.cgi?article=1058&context=jtla>
- Edyburn, D. (2005). Assistive technology and

- students with mild disabilities: From consideration to outcome measurement. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *The handbook of special education technology research and practice* (pp. 239-270). Whitefish Bay, WI: Knowledge by Design.
- Gallagher, A., Bridgeman, B., & Cahalan, C. (2002). The effect of computer-based tests on racial/ethnic and gender groups. *Journal of Educational Measurement*, 39, 133-147.
- General Supervision Enhancement Grant, Technical Assistance and Dissemination to Improve Outcomes for Children with Disabilities (84.326)
- Goldman, S. R., Semmel, D. S., Cosden, M. A., Gerber, M. M., & Semmel, M. I., (1987). Special education administrators' policies and practices on microcomputer acquisition, allocation and access for mildly handicapped children: Interfaces with regular education. *Exceptional Children*, 53, 330-340.
- Hansen, E. G., Forer, D., & Lee M. J. (2004). *Toward accessible computer-based tests: Prototypes for visual and other disabilities*. (ETS Research Report. No. RR-04-25). Princeton, NJ: Educational Testing Service.
- Hansen, E. G., Lee M. J., & Forer, D. C. (2002). A 'self-voicing' test for individuals with visual impairments. *Journal of Visual Impairment and Blindness*, 96, 273-275.
- Henry F. Moss Middle School. (2005). *CATS performance data*. Bowling Green, KY: Warren County Schools.
- Higgins, E. L., & Zvi, J. (1995) Assistive technology for postsecondary students with learning disabilities: *From research to practice*. *Annals of Dyslexia*, 45, 123-142.
- Individuals with Disabilities Education Act Amendments, 20 U.S.C. § 1400 *et seq.* (1997)
- Individuals with Disabilities Education Improvement Act, 20 U.S.C. § 1400 *et seq.* (2004)
- Johnstone, C. J., Altman, J., Thurlow, M. L., & Thompson, S. J. (2006). *A summary of research on the effects of test accommodations: 2002 through 2004* (Technical Report 45). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- Kentucky Department of Education. (2005). *CATS online post test student survey*. Frankfort, KY: Author.
- Kentucky Administrative Regulation (KAR) Title 703, Chap 5. Retrieved May 23, 2007, from <http://www.lrc.ky.gov/kar/703/005/070.htm>
- Kentucky Department of Education. (2006). *CATS online student participation data*. Frankfort, KY: Author.
- Kentucky Department of Education. (2007). *Pathway to achievement: Universal design for learning (UDL)*. Retrieved May 7, 2007, from <http://education.ky.gov/KDE/Instructional+Resources/Curriculum+Documents+and+Resources/Universal+Design+for+Learning/>
- Koenig, J. A., & Bachman, L. F. (2004). *Keeping score for all: The effects of inclusion and accommodation policies on large scale educational assessment*. Washington, DC: National Academy Press.
- Lawrence, B. (2005, March). Technology supports instruction and CATS assessment. *Kentucky Teacher Newsletter*. Frankfort, KY: Kentucky Department of Education.
- Lazarus, S. S., Thurlow, M. L., Lail, K. E., Eisenbraun, K. D., & Kato, K. (2006). *2005 state policies on assessment participation and accommodations for students with disabilities* (Synthesis Report 64). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- McGrew, K. S., Thurlow, M. L. & Spiegel, A. N. (1993). An investigation of the exclusion of students with disabilities in national data collection programs. *Educational Evaluation and Policy Analysis*, 15, 339-352.
- Minnesota Department of Education. (2007a). *Policies, procedures & guidelines*. Retrieved May 7, 2007, from <http://education.state.mn.us/mde/Accou>

- [ntability Programs/Assessment and Testing/DAC Corner/Policies Procedures Guidelines/index.html](http://education.mn.us/mdeprod/groups/Assessment/documents/Manual/011664.pdf).
- Minnesota Department of Education. (2007b). *Procedures manual for the Minnesota assessments*. Retrieved May 7, 2007, from <http://education.state.mn.us/mdeprod/groups/Assessment/documents/Manual/011664.pdf>.
- Minnesota Department of Education. (2007). *Technical Assistance and Dissemination to Improve Results for Children with Disabilities*. Grant submitted to the U.S. Department of Education.
- No Child Left Behind Act, 20 U.S.C. § 6301 *et seq.* (2001)
- Okolo, C. M., Rieth, H. J., & Bahr, C. M. (1989). Microcomputer implementation in secondary special education programs: A study of special educators' mildly handicapped adolescents', and administrators' perspectives. *Journal of Special Education*, 23, 107-117
- Parette, H.P., Peterson-Karlan, G.R., Smith, S.J., Gray, T., & Silver-Pacuilla, H. (2006). The state of assistive technology: Themes from an outcomes summit. *Assistive Technology Outcomes and Benefits*, 3, 15-33.
- Porkorni, J. L. (2005, April). *Using technology for success in high stakes testing for students with learning disabilities*. Poster session presented at the Council for Exceptional Children Annual Convention and Expo, Baltimore, MD.
- Rose, D. H., Hasselbring, T. S., & Zabala, J. (2004). Assistive technology and universal design for learning: Two sides of the same coin. In D. Edyburn & R. Boone (Eds.), *The handbook of special education technology research and practice* (pp. 507-518). Whitefish Bay, WI: Knowledge by Design.
- Shriner, J. G., Spande, G. E., & Thurlow, M. L. (1994). *State special education outcomes 1993*. Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved May 9, 2007, from <http://education.umn.edu/nceo/OnlinePubs/StateSpecEducOutcomes1993.pdf>
- Stone, E., Cook, L., Laitusis, C. C., & Cline, F. (2007, April). *Using differential item functioning to investigate the impact of testing accommodations on an English language arts assessment for students who are blind and visually impaired*. Paper presented at the Annual Meeting of the National Council on Measurement in Education, Chicago, IL.
- Thompson, S., Blount, A., & Thurlow, M. (2002). *A summary of research on the effects of test accommodations: 1999 through 2001* (Technical Report 34). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- Thurlow, M. L. (2007). *State policies and accommodations: Issues and implications. K12 accommodations what works*. Arlington, VA: Council for Exceptional Children.
- Thurlow, M. L., Moen, R., & Altman, J. (2006). *Annual performance reports: 2003-2004 state assessment data*. Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved May 7, 2007, from <http://www.nceo.info/OnlinePubs/APRsummary2006.pdf>
- Thurlow, M., House, A., Boys, C., Scott, D., & Ysseldyke, J. (2000). *State participation and accommodation policies for students with disabilities: 1999 update* (Synthesis Report 33). Minneapolis MN: University of Minnesota, National Center on Educational Outcomes.
- Thurlow, M., Seyfarth, A., Scott, D., & Ysseldyke, J. (1997). *State assessment policies on participation and accommodations for students with disabilities: 1997 update* (Synthesis Report 29). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- Thurlow, M. L., Lazarus, S., Thompson, S., & Robey, J. (2002). *2001 state policies on assessment participation and accommodations* (Synthesis Report 46). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

- Thurlow, M. L., Scott, D. L., & Ysseldyke, J. E. (1995). *A compilation of states' guidelines for accommodations in assessments for students with disabilities* (Synthesis Report 18). Minneapolis MN: University of Minnesota, National Center on Educational Outcomes.
- Thurlow, M. L., Ysseldyke, J. E., & Silverstein, B. (1993). *Testing accommodations for students with disabilities: A review of the literature* (Synthesis Report 4). Minneapolis MN: University of Minnesota, National Center on Educational Outcomes.
- Tindal, G., & Crawford, L. (2005). Using learning assessments to design effective programs. In D. Edyburn, K. Higgins, & R. Boone (eds.), *Handbook of special education technology research and practice* (pp. 821-834). Whitefish Bay, WI: Knowledge by Design.
- Tindal, G., & Fuchs, L. (1999). *A summary of research on test changes: An empirical basis for defining accommodations*. Lexington, KY: University of Kentucky, Mid-South Regional Resource Center.
- Tindal, G., & Ketterlin-Geller, L. R. (2004). *Research on mathematics test accommodations relevant to NAEP testing*. Washington, DC: National Assessment Governing Board. Available at <http://www.nagb.org/pubs/conferences/tindal.pdf>.
- University of Kansas. (2007). *Kansas computerized assessment*. Lawrence, KA: Center for Educational Testing and Evaluation. Retrieved May 7, 2007, from <http://kca.cete.us/>
- Wikipedia. (2007). *Item response theory*. Retrieved May 7, 2007, from http://en.wikipedia.org/wiki/Item_response_theory
- Zinesky, A., & Sireci, S. (2007). *A summary of the research on the effects of test accommodations: 2005 through 2006* (Technical Report). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.
- Zlatos, B. (1994). Don't test, don't tell: Is "academic red-shirting" skewing the way we rank our schools? *American School Board Journal*, 181(11), 24-28.